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| 10/584,413 | 06/13/2007 | Yuichiro Itai | 1982-0288PUS1 | 9416 |

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| EXAMINER |
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CLARK, GREGORY D

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| ART UNIT | PAPER NUMBER |
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1786

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05/12/2010

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mailroom@bskb.com

| | | | |
|------------------------------|--------------------------------------|------------------------------------|--|
| Office Action Summary | Application No. 10/584,413 | Applicant(s) ITAI ET AL. | |
| | Examiner GREGORY CLARK | Art Unit 1786 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 February 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 11-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
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| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>11/10/2009 and 01/11/2010</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

The examiner acknowledges the receipt of applicants' arguments and pending claims dated 02/26/2010.

Rejections and objections made in previous office action that do not appear below have been overcome by applicant's amendments and therefore the arguments pertaining to these rejections/objections will not be addressed.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

1. **Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oh (US 2003/0118866) in view of Zhou (Advanced Functional Materials 2001, No. 4, P. 310-314).**

2. **Regarding Claim 1**, Oh discloses and organic electroluminescent device (OLED) with an organic multilayer composed of layers in the following order (paragraphs 10-16):

Anode

Hole injection layer (HIL)

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Hole transport layer (HTL)

Light emitting Layer (luminescent layer)

Electron transporting layer (ETL)

Electron injecting layer (EIL)

Cathode

The above device disclosed by Oh shows:

HTL adjacent to the positive-electrode (anode) side of the luminescent layer

ETL adjacent to the negative-electrode (cathode) side of the luminescent layer

HIL located between the HTL and positive-electrode (anode)

HIL adjacent to the anode (positive electrode)

Oh fails to show an EIL adjacent to the cathode (negative electrode) side of the organic emitting layer (luminescent layer).

The examiner takes the position that the EIL and ETL play similar roles in facilitating the flow of electrons.

For this reason, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have used one for the other as in Oh. Thus, rendering the EIL adjacent to the cathode (negative electrode) side of the organic emitting layer with the resulting device having similar performance.

Oh fails to mention the conductivity of the HIL continuously changes along a thickness direction of the HIL.

Zhou discloses an OLED with an HIL where the layer thickness can be controlled by an evaporation process and the concentration of the component(s) that makes up the layer affect the conductivity.

The thickness the HIL based the concentration component(s) that make up the layer is viewed as a cause effective variable to affect the conductivity of the HIL. Where an increased concentration of a given component would be expected to produce a layer with a high conductivity.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to have adjusted the thickness of the HIL to optimize the conductivity which would have included a continuous change along the thickness direction of the HIL.

3. **Regarding Claim 2,** Oh fails to mention a HIL that includes 2 an acceptor.

Zhou discloses an OLED where the HIL contains a strong acceptor, 2,3,5,6-tetrafluoro-7,7,8,8 tetracyanoquinodimethane (F4-TCNQ) (page 310) which leads to OLED(s) that exhibit lower driving and operating voltages (abstract).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to have modified the HIL of Oh by including the acceptor taught by Zhou since Zhou discloses that the presence of an acceptor in the HIL leads to OLED(0) that exhibit lower driving and operating voltages.

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4. **Regarding Claim 9**, Oh discloses an OLED where the HIL is made from copper phthaiocyanine (paragraph 11). Oh fails to mention a HIL made from 4,4',4"-tris(N, N-diphenylamino)triphenylamine (TDATA). The use of F4-TCNQ as an acceptor in the HIL was discussed in section 3.

Zhou discloses an OLED with enhanced hole injection (abstract) where the HIL is made of a starburst amine, TDATA (page 310).

As the prior art teaches the use of phthaiocyanine and TDATA in a HIL of an OLED, these materials are considered as functional equivalents and would be readily exchangeable. An OLED with a HIL composed of TDATA would be expected to have similar properties to a HIL composed of phthaiocyanine.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to have modified the HIL of Oh by adding the TDATA and F4-TCNQ of Zhou since Zhou discloses the HIL shows enhanced hole injection with TDATA (abstract and page 310) and the OLED operates at a lower drive voltage with F4-TCNQ (abstract).

5. **Regarding Claim 3**, Oh and Zhou teach the invention of claim 1, Oh and Zhou fail to mention the acceptor in the HIL changes continuously along the thickness direction of the HIL.

Zhou discloses that TDATA and F4-TCNQ are prepared by coevaporation which can be controlled independently measuring them separately with quartz thickness monitors allowing the ratio to be controlled (gradient thickness) (page 311). Zhou

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mentions that the conductivity of the film (HIL) increases with dopant (F4-TCNQ) concentration (thickness).

Whereas Oh and Zhou teach the controlled thickness of F4-TCNQ in the HIL that affects conductivity, it would have been obvious to deposit the F4-TCNQ evenly (continuously) in the thickness direction across the HIL to ensure a uniform enhancement of conductivity.

6. **Regarding Claims 4, 6, 5 and 7**, Oh and Zhou teach the invention of claim 1. Oh mentions the HIL adjacent to the HTL but fails to mention a border region with a reduced acceptor concentration formed in the vicinity of the HIL-HTL interface or that the acceptor concentration changes by at least 10% in the vicinity of the HIL-HTL interface.

Zhou discloses that TDATA and F4-TCNQ are prepared by coevaporation which can be controlled independently measuring them separately with quartz thickness monitors allowing the ratio to be controlled (gradient thickness) (page 311). Zhou mentions that the conductivity of the film (HIL) increases with dopant (F4-TCNQ) concentration (thickness).

The thickness of a given region of the HIL based the concentration of TDATA and F4-TCNQ is viewed as a cause effective variable to affect the conductivity of the HIL.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to have adjusted the acceptor concentration in the vicinity of the HIL-HTL interface to optimize the conductivity of the HIL which would have included a reduction in the acceptor concentration at the HIL-HTL interface and an acceptor concentration change by at least 10% in the vicinity of the HIL-HTL interface.

7. **Regarding Claim 8**, Oh and Zhou teach the invention of claim 2, Oh and Zhou fail to mention the HIL has first and second border regions with reduced acceptor concentrations in the vicinity of the HIL-HTL interface and in the vicinity of another HIL-HTL interface and the positive electrode (anode), respectively.

Zhou discloses a method that control the thickness of the acceptor and indicates the doped (acceptor containing) HIL(s) give OLED(s) with lower driving voltages, lower operating voltages (abstract), and higher efficiencies (page 314).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to have adjusted the acceptor concentration in multiple regions in the vicinity of the HIL-HTL interface to optimize the conductivity of the HIL which would have included a reduced acceptor concentrations in the vicinity of the HIL-HTL interface and in the vicinity of another HIL-HTL interface and the positive electrode (anode).

8. **Regarding Claim 10**, Oh discloses an OLED where the positive electrode (anode) is made of indium-tin oxide (conductive oxide) (paragraph 10). Oh discloses

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that the HIL has a thickness of 10 to 30 nm. The applicant claims a thickness of 40-50 nm.

The thickness taught by Oh is not exactly the same as applicant but there is substantial overlap. It would have been obvious to a person of ordinary skill in the art at the time of the invention to have adjusted the thickness of the HIL to optimize the conductivity as discussed in section 5 which would have included the overlapping portion of the ranges, absent unexpected results.

Response to Arguments

All rejections based on Kim (US 7,297,417) are withdrawn. A new set of rejections are included based on Oh (US 2003/0118866).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GREGORY CLARK whose telephone number is (571)270-7087. The examiner can normally be reached on M-Th 7:00 AM to 5 PM Alternating Fri 7:30 AM to 4 PM and Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Larry Tarazano can be reached on (571) 272-1515. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/D. Lawrence Tarazano/
Supervisory Patent Examiner, Art Unit 1786

GREGORY CLARK/GDC/
Examiner
Art Unit 1786